
# Naval Postgraduate School
# Operations Analysis Curriculum (360)

**Y2K**


| | |
|---|---|
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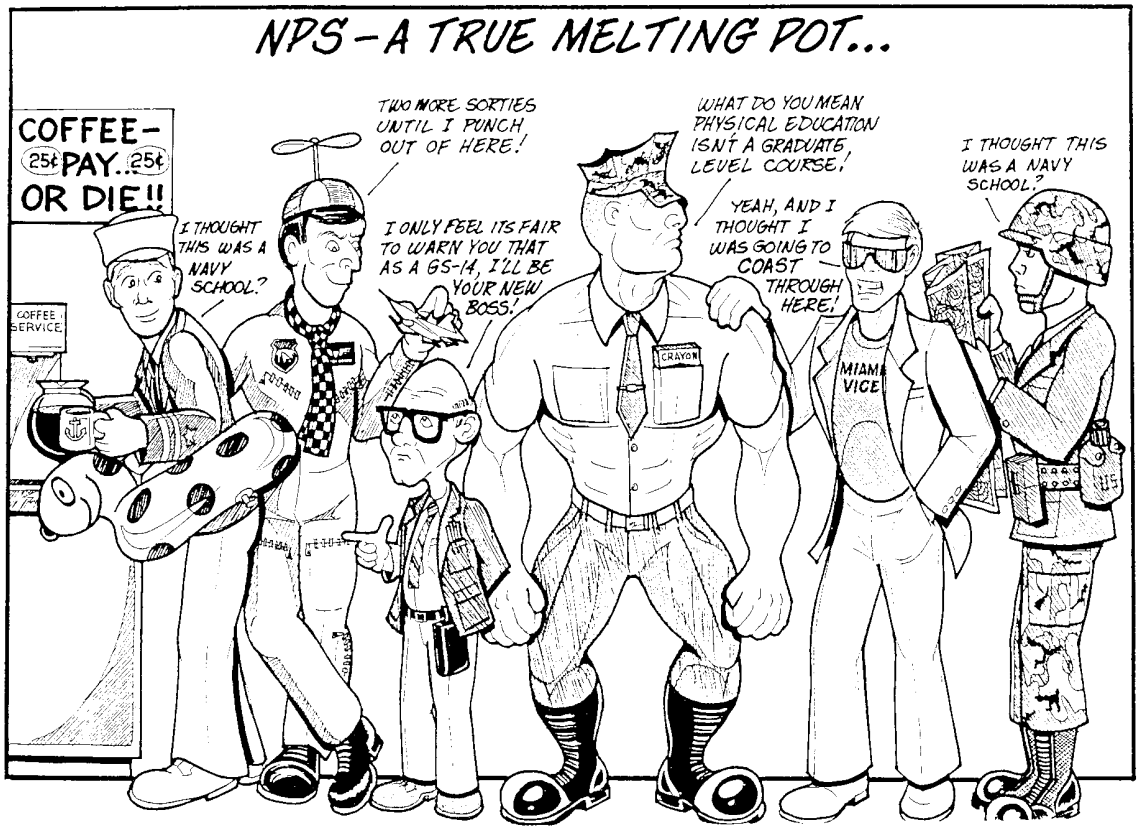
# TABLE OF CONTENTS

## Introduction

Welcome to the Naval Postgraduate School and the Operations Analysis (OA) Curriculum, a seven quarter curriculum leading to the degree Master of Science in Operations Research (MS/OR). The Navy established the curriculum in 1951 when it recognized that the OR techniques pioneered in WWII were worth preserving, and has maintained it ever since. By now, as the cartoon[1] shows, all services and even an occasional DoD civilian can be found in attendance. A small number of foreign officers are also admitted. NPS distinguishes between the OA curriculum, a course of study, and the OR department, a collection of faculty. The rest of the world may not distinguish between OA and OR, and may use terms such as Management Science or Systems Analysis to refer to essentially the same thing. Whatever the name, the subject is scientific decision making as applied to tactics, strategy, logistics, force planning, etc.

The Navy sponsor for the OA curriculum is the Director of the Assessment Division (N81). Navy graduates may spend a tour there, or in one of many other billets that require the xx42 P-code. Other services have similar coding systems. We think that the techniques and attitudes that you will learn here will prove to be of practical and intellectual value to you throughout your career and life, whether you are serving in a coded billet or not.




[1] This cartoon, as well as the Ratman cartoons in the sequel, was drawn by Gus Stafford, an OA alumnus who graduated in 1990

On account of the wide spectrum of interests found in the student body, the OA curriculum has developed several *options* that will be described later. All lead to the same degree and the same P-code. You should select an option by the end of your third quarter. You will also need to select a few electives and possibly a thesis tour site. These choices should be made under the guidance of the OA curricular officer, the option advisor, and the OA academic associate. The academic associate and the curricular officer function as a team that is responsible for the general welfare of the OA curriculum, taking into account guidance from the sponsor and feedback from you. Take advantage of the presence of these advisors, particularly (once you have selected an option) the option advisor.

Most of the classes that you attend will have identifying numbers that begin with the two letters OA, which means that the course is the responsibility of the OR department. Most of the students that you meet in these courses will be in the OA curriculum, the principal exception being students from the Operational Logistics (OL) curriculum and the MOVES curriculum. The OL and OA curricula both lead to the MS/OR degree, but the sponsor and P-code for OL are different. The MOVES curriculum leads to a different degree.

## Graduation Requirements

NPS has the usual A, B, C,… grading system, with an A being 4 points, an A-minus 3.7 points, a B-plus 3.3 points, a B 3 points, a B-minus 2.7 points and so forth. Throughout your tenure at NPS, the registrar will compute and report to your advisors various statistics concerning your performance to date. The most important of these is the Graduate Quality Point Rating (GQPR), the average grade obtained in all "graduate" courses (courses whose identifier numbers start with either 3 or 4 and which are not pass/fail). Your GQPR must exceed 3.0 (a B average) if you are to be awarded any MS degree at NPS. There are other grade point requirements, but it is hard to flunk them while passing the GQPR test. In general, OR students tend to earn higher grades in graduate level courses, so it is natural for GQPR to gradually increase as you proceed through the curriculum. A GQPR of 2.95 after three quarters is therefore cause for concern rather than despair. Even so, any GQPR less than 3.0 is worth some introspection and consultation. A small fraction of students who complete the OA curriculum are not awarded the MS/OR degree. Among those who are not, the most common reason is GQPR<3.0. The next most common reason is failure to finish a thesis. There are also some requirements concerning the courses taken. You are unlikely to get in trouble on this score, but still it is worth recording the two most important requirements: NPS requires at least 32-quarter hours of graduate (3000 or 4000 level) courses, plus a thesis, and the OR department requires at least 20-quarter hours of 4000 level courses, of which 16 quarter hours must be OA. The quarter hours for each course are stated in the catalog and in the option matrices at the end of this introduction. A 3-1 course counts for 3.5 quarter hours because the second "lab" component is given only half the weight of the first "lecture" component. A complete list of all graduation requirements, including those mentioned above, can be found in the Academic Council Policy Manual, available from the NPS home page at http://www.nps.navy.mil/. The OR department's home page is also worth investigating, since it includes information about the research and teaching interests of the faculty, as well as this document.

## OA Options

Each option is shown at the end of this introduction as a 7x4 matrix with the cell entries being course identifiers. Each row shows the four courses or equivalent usually taken in that quarter. The fifth quarter is set off because it includes the thesis tour, the first block of time that is set aside for working on your thesis. Many students leave NPS to work directly with a sponsor during this period. The two courses at the beginning of the fifth quarter are accelerated; that is, they meet twice as often for only six weeks. Not shown are options in Artificial Intelligence (see Professor Bradley) and Medical Service Corps (see Professor Krebs).

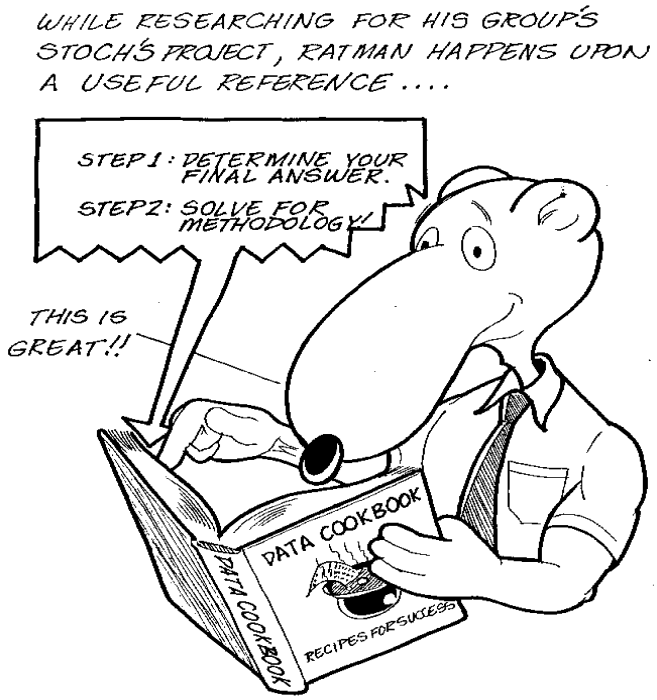
## Core Courses

Options differ very little from each other before the thesis tour, so it is reasonable to refer to those courses as a common "core". OR is a quantitative discipline, and the core is designed to introduce the required ideas, tools, and software. The OA3101, 2, 3 sequence is devoted to probability and statistics, including some of the graphical methods that the microcomputer revolution has made possible. The OA3201, OA4202, OA4201 sequence introduces optimization, beginning with linear programming in OA3201 and progressing to various generalizations and special cases in the other two. Stochs I (OA3301) deals with random phenomena that fluctuate with time. The OA3302, OA4604, OA4655 sequence introduces a variety of techniques useful for modeling and simulating combat. By the time you begin work on your thesis, you should have a solid technical background that will be tailored and rounded out in the last two quarters.

## Electives

Electives are usually OA-xxxx courses, but you may also consider courses taught by other departments. The Stochs II elective (OA4301) has a project, as you can probably gather from Stafford's cartoon on the next page. The objective should be to round out your education, to go more deeply into some subject that interests you, or to learn something that supports your thesis.

There are a few constraints on elective choices. They must be approved by your advisors, for one thing, and even with everyone's approval, you can't take a course if it isn't offered. Course scheduling in the OR department is done by the Associate Chairman for Instruction (ACI), who has a budgetary limit that essentially determines the number of sections that can be offered in a given year. In early September he receives a demand forecast for the next fiscal year and makes a tentative teaching plan. NPS collects this information and in November releases the "tentative course schedule" for the rest of the academic year. It usually doesn't change much from year to year. This schedule is worth looking at if you are wondering what electives to take, but remember that it is only tentative. Courses are taught in accordance with what demand actually turns out to be. Actual demand can differ a lot from the forecast, particularly late in the fiscal year. What this means to you is that you can influence the electives that are actually taught by mentioning your desires to the ACI, signing up for electives as early as possible, and by convincing your classmates to do likewise. Roughly speaking, electives get taught in the same order as they get voted for, provided the votes come in early enough to permit faculty to plan their lives.




## The OR Department

Most of the courses that you take will be taught by one of the approximately 30 faculty in the OR department. These same faculty are also likely to be involved as either advisors or second readers when you write your thesis. Most faculty are civilians with PhD's in a variety of areas, but there are also several military instructors. The easiest way to find out about the faculty is by browsing the department's home page, where you will find information about background, interests, publications, and thesis advising. If you find someone whose interests appear to overlap with your own, stop by and introduce yourself.

In case you are curious, life for a civilian faculty member usually consists of alternating quarters of research and teaching, with thesis advising and other academic duties going on continuously. Research is funded by the conventional academic mechanism of writing research proposals. The NPS contract is for 10 months, but most faculty extend it to 12 months with funded research. Much of this research is funded by the armed services -- this is the so-called "reimbursable" research that in most years makes the NPS budget feasible. All of this requires a certain amount of planning ahead, which partly explains why we are not as flexible with regard to offering electives as we would like to be.

## Professional Societies

The Institute of Management Science and the Operations Research Society of America were combined in 1995 to form INFORMS (neat, huh? they got OR and MS and everything right in there), the main US society for our profession. INFORMS publishes several journals, the most readable of which is *Interfaces.* You might wish to browse through a copy, and more specifically you might wish to browse through vol 26 number

5, which includes an article on the OA curriculum! INFORMS also publishes a magazine, *OR/MS Today,* that is available, along with several other benefits, by joining the society as a student for $25 per year. Application forms are available from the academic associate. INFORMS has a Military Applications Society (MAS) that you can select upon joining. For more information about INFORMS, see the web site at http://www.informs.org/.

INFORMS and its captive society, MAS, are an entirely unclassified forum, which distinguishes them from the Military Operations Research Society (MORS). MORS meetings have classified sessions, and are usually held at military bases, occasionally NPS. MORS and MAS together publish the unclassified *PHALANX* newsletter, which comes free if you join INFORMS/MAS (it also comes free even if you don't, since the curricular office gets a supply to give away). MORS sponsors the Tisdale award for the best military OR thesis. The competition for this award occurs right before graduation.

The original OR journal was *Operations Research*, which is still published by INFORMS. Other relevant journals are *Management Science*, *Naval Research Logistics* (Professor Rosenthal is the editor), *European Journal of Operations Research,* and the journals produced by the OR societies in several other countries. The NPS library subscribes to all of those named plus several others.

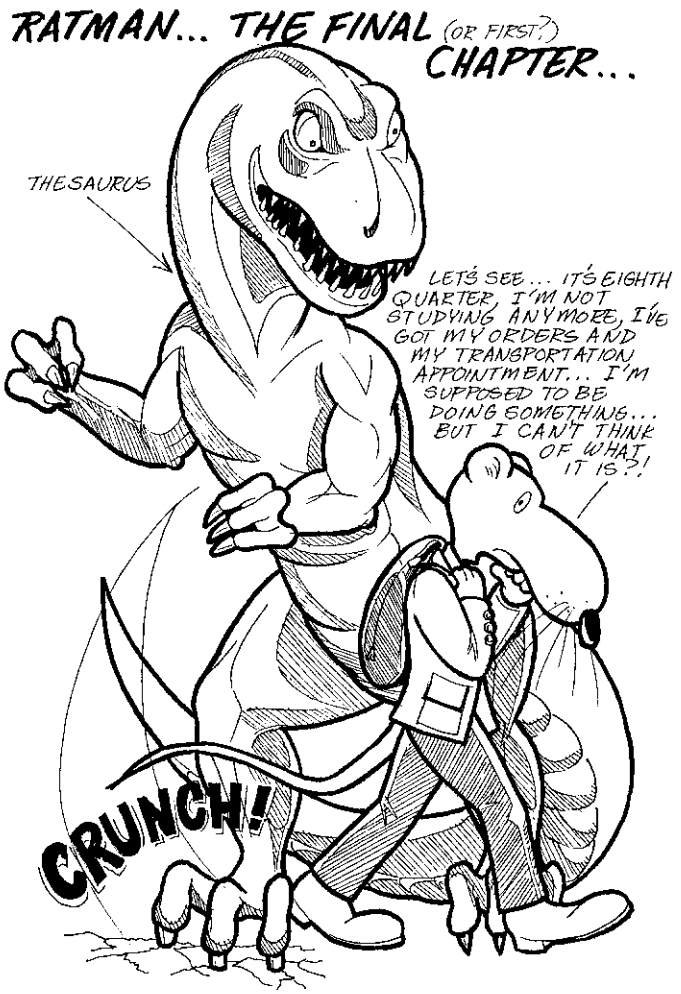
## Thesis

All OA options include some thesis "slots" in quarters 5, 6, and 7. Most students say that the completion of a thesis requires more time than those slots would seem to imply. In fact, many schools have stopped requiring a thesis for the MS/OR degree due to the large time commitment on the part of both students and faculty. However, a thesis is still very much a requirement at NPS. *After* your thesis is complete, you will probably join most other alumni and faculty in defending it as having been worth the time and effort.

Begin planning your thesis right after you finish reading this, and expect to have at least a rough idea of what your topic is going to be by the end of the third quarter. The OR department publishes a separate document *Guidelines for Students Writing Theses in Operations Research* that is available in the curricular office and worth consulting. A Preliminary Report of Thesis is due by the third week of the fifth quarter, by which time you should know enough about your topic to describe it in a couple of pages. To avoid a visit by Ratman's "Thesaurus" monster, it is best to begin planning early.

The best source of thesis topics is your own experience. One of the beauties of OR is that our quantitative approach to decision making is applicable to such a wide variety of circumstances that there is likely to be something in your background that hasn't been analyzed quantitatively, but could be. Theses have been made out of the observations that a submarine has to decide what heading will minimize the chance of collision when coming to periscope depth, or that an LCAC must decide how much equipment to load from which mother ship in supporting an invasion, or that a particular change in personnel policy may or may not have resulted in jobs being performed better in a particular set of billets. All of these topics were chosen based on prior experience of the authors. In fact, one of the reasons why NPS can still afford to require a thesis is that

NPS students are comparatively mature and experienced. Capitalize on your experience in selecting a topic.




The topics named above may sound overly simple, but they are not. "Chance of collision" begs to have a model of how collisions involving submarines and surface ships might occur. The LCAC is trying to do things fast, so it will shortly realize that the relationship between time and quantity in loading needs to be clearly understood, and that it needs to know what other LCACs are doing. How does one quantify "better performance" in a billet, and can the relevant statistics be estimated from available data? Considerations such as these can make a deceptively simple sounding problem turn out to be surprisingly complex. *Any OR research topic has a tendency to grow*, so the risk of selecting a problem that is trivial is much smaller than the risk of selecting a problem that is too big for the time available. An OR thesis is intended to be a scientific undertaking, so the details will take time. The devil (or worse yet, Ratman's Thesaurus) is often found in those details. Start small.

The curricular office keeps a compilation of thesis abstracts that will give you a good idea of the kind of OR theses that have been written in the past. A copy of each thesis can be found in the library, including theses that are classified. Faculty can also be

a source of thesis topics. If a lecture topic intrigues you, or if you think an introduced technique might be applicable to a thesis you have in mind, discuss it with the faculty member. Sponsors sometimes call faculty about problems that need to be solved. Ideally these calls will result in an entry in the catalog of prospective thesis topics at http://web.nps.navy.mil/~opnsrsch/oacurric/projects-table.htm, but a direct approach to faculty can also be useful.

Your thesis advisor is the most important faculty thesis contact. The thesis work is yours to do and yours to communicate, but the advisor is your consultant throughout. Every thesis must also have a second reader. The usual role for a second reader is basically quality control and making sure that the thesis is comprehensible by someone not intimately connected with the work; however, the arrangement will depend on the faculty member that you select. As with your advisor, make sure that you understand what your second reader expects and when he expects it. At least one of these two advisors must be an OR faculty member, and at least one, not necessarily the same person, must have a PhD. If you have trouble finding appropriate faculty, talk to the academic associate. As soon as you have a topic and advisors lined up, but not later than the middle of the fifth quarter, complete the required thesis proposal and have everyone sign it.

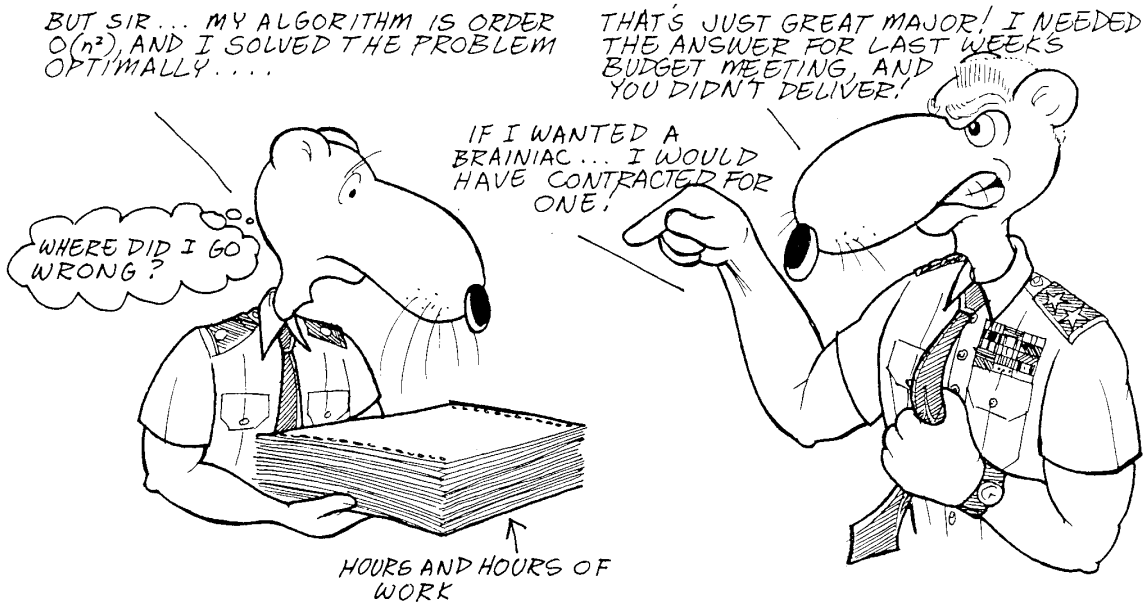
NPS has a Thesis Manual that specifies standards for how a thesis must be written and a thesis processor to make sure that the standards are followed. The curricular office will make sure that you are aware of all the latest details. However, the most important rule for good writing is to first make sure that you have something to say. Before beginning your write-up, consult with your advisor as to whether you have reached that desirable state.

## After Graduation

It sometimes happens that a thesis tour is undertaken by a student who is wondering how anybody can even comprehend four and a half quarters of OR techniques, let alone apply them, only to be pleasantly surprised at being able to do something that others regard as actually useful! The useful technique may simply be the ability to write a computer program or correctly interpret a probability analysis, rather than one of the more esoteric parts of OR. The same thing often happens to recent graduates. It turns out that a byproduct of all the mathematics and abstraction that comes with studying OR is a certain confidence about making decisions using computers, models and numbers. This sophistication often leads to an effortless clarity of thinking that is valuable in itself and enviable to those without a similar education. The real goal of the NPS OA curriculum is to give you the opportunity to become sophisticated in that sense. If you can get there, you will be a more effective decision maker during your career in the military, and probably in whatever you do after you leave. Your effectiveness will only occasionally take the form of a sophisticated analysis, but your approach to problems will still be valued.

We like to get feedback from alumni. We occasionally even attempt a survey, although our surveys usually suffer from our inability to keep track of rapidly moving graduates. It is much easier for you to keep track of us, since the OA curriculum has been in Monterey since 1951. Please keep in touch, either through the mail (zip code is 93943) or the OR home page.

FOLLOWING GRADUATION, RATMAN IS GIVEN A REALITY CHECK...




IF YOU CAN'T SEE THE FOREST FOR THE TREES... CUT THE TREES DOWN FOR COMPUTER PAPER AND WRITE AN ALGORITHM!

**Fall Quarter AY-2000**

Reporting Date ..... 20 Sept 1999
Instruction Begins ..... 27 Sept
Columbus Day (Holiday) ..... 11 Oct
Reporting Date for Refresher ..... 1 Nov
Refresher Begins ..... 8 Nov
Veteran's Day (Holiday) ..... 11 Nov
Thanksgiving Day (Holiday) ..... 25 Nov
Final Examinations Begin ..... 13 Dec
Graduation ..... 16 Dec
Christmas Break ..... 17 Dec – 7 Jan 2000
Christmas (Federal Holiday) ..... 24 Dec
New Year's (Federal Holiday) ..... 31 Dec

**Winter Quarter AY-2000**

Reporting Date ..... 3 Jan
Instruction Begins ..... 10 Jan
Martin Luther King's Birthday (Holiday) ..... 17 Jan
Reporting Date for Refresher ..... 7 Feb
Refresher Begins ..... 22 Feb
Presidents Day (Holiday) ..... 21 Feb
Final Examinations Begin ..... 27 Mar
Graduation ..... 30 Mar

**Spring Quarter AY-2000**

Reporting Date ..... 27 Mar
Instruction Begins ..... 3 Apr
Reporting Date for Refresher ..... 8 May
Refresher Begins ..... 15 May
Memorial Day (Holiday) ..... 29 May
Final Examinations Begin ..... 19 Jun
Graduation ..... 21 Jun
Summer Break ..... 23 Jun - 7 Jul

**Summer Quarter AY-2000**

Reporting Date ..... 28 Jun
Independence Day ..... 4 Jul
Instruction Begins ..... 10 Jul
Reporting Date for Refresher ..... 14 Aug
Refresher Begins ..... 21 Aug
Labor Day (Holiday) ..... 4 Sep
Final Examinations Begin ..... 25 Sep
Graduation ..... 28 Sep

**Fall Quarter AY-2001**

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|---|---|
| Reporting Date | 25 Sept 1999 |
| Instruction Begins | 2 Oct |
| Columbus Day (Holiday) | 9 Oct |
| Reporting Date for Refresher | 6 Nov |
| Veteran's Day (Holiday) | 10 Nov |
| Refresher Begins | 13 Nov |
| Thanksgiving Day (Holiday) | 23 Nov |
| Final Examinations Begin | 18 Dec |
| Graduation | 21 Dec |
| Christmas Break | 22 Dec – 5 Jan 2001 |
| Christmas (Federal Holiday) | 24 Dec |
| New Year's (Federal Holiday) | 31 Dec |

**Winter Quarter AY-2001**

| | |
|---|---|
| Reporting Date | 2 Jan |
| Instruction Begins | 8 Jan |
| Martin Luther King's Birthday (Holiday) | 15Jan |
| Reporting Date for Refresher | 12 Feb |
| Presidents Day (Holiday) | 19 Feb |
| Refresher Begins | 20 Feb |
| Final Examinations Begin | 26 Mar |
| Graduation | 29 Mar |

**Spring Quarter AY-2001**

| | |
|---|---|
| Reporting Date | 26Mar |
| Instruction Begins | 2 Apr |
| Reporting Date for Refresher | 7 May |
| Refresher Begins | 14 May |
| Memorial Day (Holiday) | 28 May |
| Final Examinations Begin | 18 Jun |
| Graduation | 21 Jun |
| Summer Break | 22 Jun - 6 Jul |

**Summer Quarter AY-2001**

| | |
|---|---|
| Reporting Date | 2 Jul |
| Independence Day | 4 Jul |
| Instruction Begins | 9 Jul |
| Reporting Date for Refresher | 13 Aug |
| Refresher Begins | 20 Aug |
| Labor Day (Holiday) | 3 Sep |
| Final Examinations Begin | 24 Sep |
| Graduation | 27 Sep |

## OA Options

# ENGINEERING SCIENCE CURRICULA (460)

**ACADEMIC ASSOCIATE: ASSOCIATE PROFESSOR ROBERT DELL, x2853**

## SIX WEEK

| | | | | |
|---|---|---|---|---|
| **R** | **OA-R200 (2-2)**<br>Introduction to Visual Basic for OR[1] | **MA-R117 (3-3)**<br>Refresher: Single Variable Calculus[1] | **MA-R142 (2-0)**<br>Refresher: Matrix Algebra[1] | **MA-R125 (3-0)**<br>Introduction to Finite Mathematics[1] |

## ONE QUARTER

| | | | | |
|---|---|---|---|---|
| **1** | **OA-R100 (V-0)**<br>Introduction to Computational Methods for OR[1]<br>_____<br>**OA-R200 (2-2)**<br>Introduction to Visual Basic for OR[1] | **MA-1117 (5-2)**<br>Single Variable Calculus | **MA-1025 (4-0)**<br>Finite Mathematics for Operations Research | **MA-1042 (2-0)**<br>Matrix Algebra |

## TWO QUARTERS

| | | | | |
|---|---|---|---|---|
| **1** | **NW-3230 (4-0)**<br>Strategy and Policy | **MA-1117 (5-2)**<br>Single Variable Calculus | **CS-3010 (4-0)**<br>Computer Systems Principles | **XX-XXXX**<br>Elective[2] |
| **2** | **OA-R100 (V-0)**<br>Introduction to Computational Methods for OR[1]<br>_____<br>**OA-R200 (2-2)**<br>Introduction to Visual Basic for OR[1] | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-1025 (4-0)**<br>Finite Mathematics for Operations Research | **MA-1042 (2-0)**<br>Matrix Algebra |

NOTES:
(1) Accelerated six week course.
(2) Elective selection must be approved by Academic Associate and Curricular Officer.

# OPERATIONS ANALYSIS CURRICULUM (360)

## NAVY MODELING SIMULATION, AND ANALYSIS OPTION

"Navy standard"

OPTION ADVISOR: TIMOTHY ANDERSON, X3583

| | | | | |
|---|---|---|---|---|
| **1** | **OA-2600 (3-1)**<br>Introduction to OR | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-3042 (4-0)**<br>Linear Algebra | **OA-3101 (4-1)**<br>Probability |
| **2** | **OA-2200 (4-1)**<br>Computational Methods for OR | **MA-3110 (3-0)**<br>Intermediate Analysis | **NW-3230 (4-0)**<br>Strategy and Policy | **OA-3102 (4-2)**<br>Statistics |
| **3** | **OA-3201 (4-0)**<br>Linear Programming | **OA-3301 (4-0)**<br>Stochastic Models I | **OA-3401 (4-0)**<br>Human Performance Measurement | **OA-3103 (4-1)**<br>Data Analysis |
| **4** | **OA-4202 (4-0)**<br>Networks | **OA-3302 (4-0)**<br>Simulation | **OA-3602 (4-0)**<br>Search Theory and Detection | **OA-4655 (4-0)**<br>Joint Combat Modeling |

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| **5** | **OA-4201 (4-0)**<br>Nonlinear Programming | **OA-4604(4-0)**<br>Wargaming Analysis |
| | **VARIABLE LENGTH THESIS TOUR** | |

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| **6** | **OA-4602 (4-0)**<br>Joint Campaign Analysis | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Thesis Research or Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **7** | **OA-4702 (4-0)**<br>Cost Estimation | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Elective or Thesis Research | **OA-0810 (0-8)**<br>Thesis Research |

Electives must include one of either MN-4613 (Theory of Systems Analysis) or OA-4301 (Stochastic Models II)
Unshaded courses are core courses taken by all OA/OL students.
Shaded courses are controlled by the option advisor and the academic associate.

APPROVED BY:

_____ Academic Associate

_____ Curricular Officer

_____ Department Chairman

_____ Option Advisor

# OPERATIONS ANALYSIS CURRICULUM (360)

# LAND COMBAT OPTION

OPTION ADVISOR: JOEL PARKER X2636

| | | | | |
|---|---|---|---|---|
| **1** | **OA-2600 (3-1)**<br>Introduction to OR | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-3042 (4-0)**<br>Linear Algebra | **OA-3101 (4-1)**<br>Probability |
| **2** | **OA-2200 (4-1)**<br>Computational Methods for OR | **MA-3110 (3-0)**<br>Intermediate Analysis | **OS-4601 (4-0)**<br>Test and Evaluation | **OA-3102 (4-2)**<br>Statistics |
| **3** | **OA-3201 (4-0)**<br>Linear Programming | **OA-3301 (4-0)**<br>Stochastic Models I | **OA-3401 (4-0)**<br>Human Performance Measurement | **OA-3103 (4-1)**<br>Data Analysis |
| **4** | **OA-4202 (4-0)**<br>Networks | **OA-3302 (4-0)**<br>Simulation | **OA-3602 (4-0)**<br>Search Theory and Detection | **OA-4655 (4-0)**<br>Joint Combat Modeling |

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|---|---|---|
| **5** | **OA-4201 (4-0)**<br>Nonlinear Programming | **OA-4604(4-0)**<br>Wargaming Analysis |
| | **VARIABLE LENGTH THESIS TOUR** | |

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| **6** | **OA-4656 (4-0)**<br>Advanced Combat Modeling | **OA-4602 (4-0)**<br>Joint Campaign Analysis | **OA-0810 (0-8)**<br>Thesis Research or Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **7** | **OA-XXXX**<br>Elective | **OA-4603 (4-0)**<br>Test and Evaluation | **OA-0810 (0-8)**<br>Elective or Thesis Research | **OA-0810 (0-8)**<br>Thesis Research |

Unshaded courses are core courses taken by all OA/OL students..
Shaded courses are controlled by the option advisor and the academic associate.

APPROVED BY:

_____ Academic Associate

_____ Curricular Officer

_____ Department Chairman

_____ Option Advisor

# OPERATIONS ANALYSIS CURRICULUM (360)

# SUPPLY CORPS OPTION

OPTION ADVISOR: KEVIN MAHER, X2691

| | | | | |
|---|---|---|---|---|
| **1** | **OA-2600 (3-1)**<br>Introduction to OR | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-3042 (4-0)**<br>Linear Algebra | **OA-3101 (4-1)**<br>Probability |
| **2** | **OA-2200 (4-1)**<br>Computational Methods for OR | **MA-3110 (3-0)**<br>Intermediate Analysis | **NW-3230 (4-0)**<br>Strategy and Policy | **OA-3102 (4-2)**<br>Statistics |
| **3** | **OA-3201 (4-0)**<br>Linear Programming | **OA-3301 (4-0)**<br>Stochastic Models I | **OA-3501 (4-0)**<br>Inventory I | **OA-3103 (4-1)**<br>Data Analysis |
| **4** | **OA-4202 (4-0)**<br>Networks | **OA-3302 (4-0)**<br>Simulation | **OA-4501 (4-0)**<br>Supply System Seminar | **OA-4655 (4-0)**<br>Joint Combat Modeling |

| | | |
|---|---|---|
| **5** | **OA-4201 (4-0)**<br>Nonlinear Programming | **OA-4604(4-0)**<br>Wargaming Analysis |
| | **VARIABLE LENGTH THESIS TOUR** | |

| | | | | |
|---|---|---|---|---|
| **6** | **MN-4310 (4-0)**<br>Logistics Engineering | **OA-4302 (4-0)**<br>Reliability | **OA-0810 (0-8)**<br>Thesis Research or Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **7** | **MN-4376 (4-0)**<br>Defense Transportation Management | **OA-0810 (0-8)**<br>Elective | **OA-0810 (0-8)**<br>Elective or Thesis Research | **OA-0810 (0-8)**<br>Thesis Research |

Unshaded courses are core courses taken by all OA/OL students..
Shaded courses are controlled by the option advisor and the academic associate.

APPROVED BY:

_____ Academic Associate

_____ Curricular Officer

_____ Department Chairman

_____ Option Advisor

# OPERATIONS ANALYSIS CURRICULUM (360)

# MARINE CORPS OPTION

OPTION ADVISOR: TOM LUCAS X3039

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|---|---|---|---|---|
| **1** | **OA-2600 (3-1)**<br>Introduction to OR | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-3042 (4-0)**<br>Linear Algebra | **OA-3101 (4-1)**<br>Probability |
| **2** | **OA-2200 (4-1)**<br>Computational Methods for OR | **MA-3110 (3-0)**<br>Intermediate Analysis | **NW-3230 (4-0)**<br>Strategy and Policy | **OA-3102 (4-2)**<br>Statistics |
| **3** | **OA-3201 (4-0)**<br>Linear Programming | **OA-3301 (4-0)**<br>Stochastic Models I | **OA-3401 (4-0)**<br>Human Performance Measurement | **OA-3103 (4-1)**<br>Data Analysis |
| **4** | **OA-4202 (4-0)**<br>Networks | **OA-3302 (4-0)**<br>Simulation | **OA-3602 (4-0)**<br>Search Theory and Detection | **OA-4655 (4-0)**<br>Joint Combat Modeling |

| | | |
|---|---|---|
| **5** | **OA-4201 (4-0)**<br>Nonlinear Programming | **OA-4604(4-0)**<br>Wargaming Analysis |
| | **VARIABLE LENGTH THESIS TOUR** | |

| | | | | |
|---|---|---|---|---|
| **6** | **OA-4656 (4-0)**<br>Advanced Combat Modeling | **MN-4613 (4-0)**<br>Theory of Systems Analysis | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **7** | **OA-4702 (4-0)**<br>Cost Estimation | **NS-3079 (4-0)**<br>PME | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **8** | **OA-4602 (4-0)**<br>Joint Campaign Analysis | **NS-3079 (4-0)**<br>PME | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Thesis Research |

Unshaded courses are core courses taken by all OA/OL students.
Shaded courses are controlled by the option advisor and the academic associate.
NS-3079 is study directed toward Marine Corps Professional Military Education.

APPROVED BY:

_____ Academic Associate

_____ Curricular Officer

_____ Department Chairman

_____ Option Advisor

## OPERATIONS ANALYSIS CURRICULUM (360)

# HUMAN FACTORS OPTION

OPTION ADVISOR: , WILLIAM KREBS, X2543

| | | | | |
|---|---|---|---|---|
| **1** | **OA-2600 (3-1)**<br>Introduction to OR | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-3042 (4-0)**<br>Linear Algebra | **OA-3101 (4-1)**<br>Probability |
| **2** | **OA-2200 (4-1)**<br>Computational Methods for OR | **MA-3110 (3-0)**<br>Intermediate Analysis | **NW-3230 (4-0)**<br>Strategy and Policy | **OA-3102 (4-2)**<br>Statistics |
| **3** | **OA-3201 (4-0)**<br>Linear Programming | **OA-3301 (4-0)**<br>Stochastic Models I | **OA-3401 (4-0)**<br>Human Performance Measurement | **OA-3103 (4-1)**<br>Data Analysis |
| **4** | **OA-4202 (4-0)**<br>Networks | **OA-3302 (4-0)**<br>Simulation | **OA-3402 (3-2)**<br>Human Factors in Systems Design | **OA-4655 (4-0)**<br>Joint Combat Modeling |

| | | |
|---|---|---|
| **5** | **OA-4201 (4-0)**<br>Nonlinear Programming | **OA-4604 (4-0)**<br>Wargaming Analysis |
| | **VARIABLE LENGTH THESIS TOUR** | |

| | | | | |
|---|---|---|---|---|
| **6** | **OA-4106 (3-1)**<br>Sample Survey Methods | **OA-4401 (3-0)**<br>Human Performance Evaluation | **OA-0810 (0-8)**<br>Thesis Research or Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **7** | **OA-4107 (4-0)**<br>Categorical Data Analysis | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Elective or Thesis Research | **OA-0810 (0-8)**<br>Thesis Research |

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Shaded courses are controlled by the option advisor and the academic associate.

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_____ Academic Associate

_____ Curricular Officer

_____ Department Chairman

_____ Option Advisor

# OPERATIONS ANALYSIS CURRICULUM (360)

# INTERNATIONAL OPTION

OPTION ADVISOR: DAVE OLWELL, X2281

| | | | | |
|---|---|---|---|---|
| **1** | **OA-2600 (3-1)**<br>Introduction to OR | **MA-1118 (5-2)**<br>Multivariable Calculus | **MA-3042 (4-0)**<br>Linear Algebra | **OA-3101 (4-1)**<br>Probability |
| **2** | **OA-2200 (4-1)**<br>Computational Methods for OR | **MA-3110 (3-0)**<br>Intermediate Analysis | **IT-1500 (4-0)**<br>International Seminar | **OA-3102 (4-2)**<br>Statistics |
| **3** | **OA-3201 (4-0)**<br>Linear Programming | **OA-3301 (4-0)**<br>Stochastic Models I | **OA-3401 (4-0)**<br>Human Performance Measurement | **OA-3103 (4-1)**<br>Data Analysis |
| **4** | **OA-4202 (4-0)**<br>Networks | **OA-3302 (4-0)**<br>Simulation | **OA-3602 (4-0)**<br>Search Theory and Detection | **OA-4655 (4-0)**<br>Joint Combat Modeling |

| | | |
|---|---|---|
| **5** | **OA-4201 (4-0)**<br>Nonlinear Programming | **OA-4604 (4-0)**<br>Wargaming Analysis |
| | **VARIABLE LENGTH THESIS TOUR** | |

| | | | | |
|---|---|---|---|---|
| **6** | **OA-4301 (3-2)**<br>Stochastic Models II | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Thesis Research or Elective | **OA-0810 (0-8)**<br>Thesis Research |
| **7** | **OA-XXXX**<br>Elective | **OA-XXXX**<br>Elective | **OA-0810 (0-8)**<br>Elective or Thesis Research | **OA-0810 (0-8)**<br>Thesis Research |

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_____ Academic Associate

_____ Curricular Officer

_____ Department Chairman

_____ Option Advisor